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Status of Atlantic salmon in Conne River, SFA 11, Newfoundland, 1999

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Abstract

Results obtained from a fish counting fence provided the basis for the assessment of the Conne River Atlantic salmon stock in 1999. Returns to home waters (river and estuary) were 2358 salmon < 63 cm in length and 241 salmon ≥ 63 cm in size. This represented a decrease of 20% for small salmon in comparison with 1998 while large salmon returns declined by 18%. Sea survival to 1SW salmon increased over the previous year but still remains low (2.80%). Only 68% of the **Management Target** was met but 122% of the **conservation spawning (egg) requirement** was attained. A mark-recapture study estimated a smolt run in 1999 of 63,658, which was 37% less than the peak run in 1997 but similar to the average from 1987 - 1995. Information on the occurrence of escaped farmed rainbow (steelhead) trout in Conne River, and results of angling activity for escaped rainbow trout during 1999 are also provided.

Résumé

Les résultats obtenus à une barrière de dénombrement ont été utilisés pour l'évaluation du stock de saumon de l'Atlantique de Conne River en 1999. Les remontées (rivière et estuaire) ont atteint 2 358 saumons de moins de 63 cm et 241 saumons de 63 cm ou plus de longueur. Par rapport à 1998, cela représente une diminution de 20% pour les petits saumons et de 18% pour les grands saumons. La survie en mer des saumons unibermarins s'est accrue par rapport à l'année précédente mais demeure faible (2,80%). **L'objectif de gestion** n'a été atteint qu'à 68% mais la **ponte nécessaire aux besoins de conservation** (nombre d'œufs) a été atteinte à 122%. Une étude par marquage-recapture a permis d'estimer la remontée des saumoneaux à 63 658 en 1999, soit 37% de moins que le pic noté en 1997, mais cette valeur se situe dans la moyenne de 1987 - 1995. On présente aussi, pour 1999, des données sur la présence dans la rivière de truites arc-en-ciel (steelhead) d'élevage échappées ainsi que les résultats de la pêche à la ligne de ces truites.

Introduction

Conne River, SFA 11 (Fig. 1) flows into Bay d'Espoir on the south coast of Newfoundland. It is a sixth-order river with a drainage area of 602 km^2 and a total length of 193 km. Since 1986, a fish counting fence has been operated to enumerate the upstream migrating population of Atlantic salmon (*Salmo salar*). Previous estimates of total returns of small salmon have ranged from a low of 1533 in 1994 to a high of 10155 in 1987. Mark-recapture studies were initiated in 1987 to survey the number of out migrating smolts and continued in 1998. Smolt production has varied from about 56 thousand in 1993 to 101 thousand in 1997.

Conne River is currently managed relative to a **Management Target** (MT) which differs and is higher than the **conservation spawning requirement**. The Management Target was based upon the estimated number of spawners required to produce the highest recorded returns to the river, which occurred in 1987. The returns were adjusted to account for the total population prior to any sea fisheries by using an assumed commercial exploitation rate.

The Management Target was met or exceeded from 1986-90, but declined to 40% in 1994 (Dempson et al. 1998). Stocking of reared fry in 1995, from brood fish maintained in 1994, increased the 'equivalent' egg deposition in 1994 to 58% of the Management Target. Increased sea survival over the 1994-95 period resulted in 82% of the Target being met in 1995 followed by 114% in 1996. A further reduction in marine survival resulted in a lower percentage of the Management Target being achieved in 1997 (70%) and 1998 (84%) (Dempson et al. 1999).

A major change in the management of the Conne River Atlantic salmon stock for 1993 was the complete closure of the recreational fishery. In light of the forecast of low salmon returns in 1994 and 1995, this closure was continued and extended to the Indian Band Council's food fishery. Both fisheries remained closed in 1996 and again in 1998 but limited food and recreational fisheries were allocated for 1997. There were no allocations to food or recreational fisheries for 1999. Pre-season forecasts of Conne River salmon abundance were not provided for 1999 (Dempson et al. 1999).

This paper summarizes smolt production and returns of adult Atlantic salmon to Conne River in 1999. Information on environmental characteristics during the 1999 season is also provided, and biological characteristic data for Atlantic salmon are updated including some data from past years. Results from the 1999 season are addressed relative to the **Management Target** as well as the **conservation spawning requirement**. Information on the occurrence of escaped steelhead (rainbow) trout in Conne River is updated and provided for reference. We have also provided a summary of numbers of people observed fishing and corresponding numbers of rainbow trout caught in the upper Bay d'Espoir area during the period February 1 to December 23, 1999. These data were collected during patrols carried out by the Conne River Aboriginal Guardians.

1999 Highlights

The following summarizes highlights to fishery regulations and other observations/events occurring in 1999:

- recreational and native food fisheries were closed again in 1999;
- sea survival from smolts (migrating in 1998) to 1SW salmon returns in 1999 remained low (2.8%) with the past three years having survival less than 3%;
- 68% of the **Management Target** was achieved in 1999; however, 122% of the **conservation spawning (egg) requirement** was attained;
- smolt production in 1999 declined by about 9% from the previous year but has declined by over 30% since the peak production recorded in 1997;
- egg-to-smolt survival has increased coincident with a decline in the egg deposition rate per unit of fluvial habitat;
- Arctic charr (*Salvelinus alpinus*) were recorded for the first time in the Conne River watershed. Several specimens were captured in the lower section of Conne River during the salmon smolt migration (April 22, 19.3 cm, 62.8 g; May 10, 18.5 cm, 46.0 g);
- Escaped farmed brook trout (*Salvelinus fontinalis*) were also caught in Conne River during 1999.

Methods

1. Landings

Information on recreational Atlantic salmon catch statistics from past years were collected by Department of Fisheries and Oceans (DFO) guardians. Similarly, previous landings of salmon from the native food fishery were obtained from the Conne River Native Band Council. Native guardians also collected information on recreational catches of escaped farmed steelhead (rainbow) trout during 1999.

2. Environmental conditions

Water temperature information was obtained from a continuous recording Hugrun thermograph located in the lower Conne River (March 24 - September 14, 1999) (Fig. 2). Information on air temperature, precipitation, and discharge was obtained from the Provincial Water Resources Management Division monitoring facility located on the main stem of Conne River, below Conne Pond.

3. Biological characteristics

Biological characteristic data on adult salmon returns in 1999, including fork length, whole weight, and age, were derived from sampling salmon captured at the fish counting fence. Biological data on Atlantic salmon smolts were obtained from specimens sampled at the downstream fish counting fence trap.

Estimates of the numbers of salmon of different life stages (1SW, 2SW, consecutive and alternate spawners) that have returned to Conne River were obtained in a manner similar to that used in previous years (Dempson et al. 1998, 1999) with some modifications this year as explained below. Salmon returning to the river were initially categorized as either small (< 63 cm) or large (≥ 63 cm) salmon. Biological characteristic data were similarly partitioned into these respective size classes and applied to numbers of returning fish. Data were available for 2319 small salmon, and 151 large salmon.

For small salmon, year specific information was applied from 1986 to 1990, and 1995-1999. For years 1991-1994, the average contribution for the years 1991-94 was used; in past years, the average for all previous years (i.e. 1986 to 1994) had been applied. Consecutive spawners within the small size category can spawn multiple times while still remaining within the < 63 cm size group (see Table 3b). Thus this year consecutive spawners within the small size category were apportioned back either one or two years coinciding with their original year in which they were virgin 1SW fish.

With respect to large salmon, numbers in each year were recalculated using the average values for the 1986-1999 period. Survival of repeat spawners was determined separately for consecutive spawning small salmon, and also by adding the subsequent numbers of consecutive and alternate spawners for both small and large salmon in each case relating the numbers back to the corresponding number of fish that originally spawned as virgin 1SW fish. As in the past, estimation of survival was constrained to the case where the consecutive or alternate spawners were associated with the previous 1SW component by a time span of either one (consecutive) or two (alternate) years only. Within the small size category, 93.0% of all samples were virgin 1SW fish, 6.9% were consecutive spawners, and 0.1% were alternate spawners. In contrast, within the large salmon component, 76.2% were alternate spawners, 17.2% were consecutive spawners and 6.6% were 2SW fish. Owing to the dependence on using average values over all years for large salmon, it is more appropriate to use year-specific information for small salmon only to examine changes in the survival of previous spawners.

Condition of smolts was determined using Fulton's condition factor (K) as follows:

$$K = W \times C / FL^3$$

where, W = whole weight in grams; C = a constant, 100,000; and FL = fork length in mm.

4. Estimated returns and spawning escapement

Adult Atlantic salmon migrants were enumerated at a fish counting fence, located about 1 km upstream from the mouth of the Conne River (Fig. 1), which operated from May 16 to September 13, 1999 (Table 1). The counting fence was monitored as a co-operative project between DFO and the Miawpukek Mi'kamawey Mawi'omi (Council of Conne River Micmacs).

During 1999, adult salmon were again counted either as they: 1) passed through monitored openings in the fish counting fence; 2) entered the trap directly; or 3) passed through openings in the fish counting fence but were recorded on the video camera system. The video camera system utilized a positive image horizontally directed camera (Panasonic model WV-BD400) positioned on the substrate and angled to view an opening in the fish counting fence. A Panasonic Time Lapse Video Recorder (Model AG 6040) was used to record the video signal from the camera and could also superimpose the time and date thus providing a summary of actual fish passage times. The video system was operated each day from June 6 until July 23 and generally from early evening until about 0900 hours the following morning.

Total river returns

Total river return (TRR) of adult salmon in have been estimated from:

$$TRR = C + Mb + Cn$$

where,
- C = the count of salmon at the counting fence
- Mb = the known mortalities (including angled salmon) below the counting fence, and
- Cn = the estimated catch of Conne River origin salmon in the native food fishery (0 fish in 1999).

Spawning escapement

Spawning escapement (SE) has been estimated as:

$$SE = FR - Ma - Br$$

where,
- FR = the number of fish released at the counting fence
- Ma = the number of known mortalities (including angled salmon) above the fence
- Br = the number of salmon removed for brood stock use (0 in 1999).

Consistent with the practise established in 1991, estimated egg deposition refers to the 'potential' deposition relative now to either the current **Management Target** or the **conservation spawning (egg) requirement**. That is, no additional adjustments have been made to account for any unknown or assumed mortality of fish up to the time of spawning. Thus, the potential egg deposition could overestimate the actual egg deposition.

Egg deposition

As in past years, egg deposition (ED) was calculated separately for salmon < 63 cm and salmon ≥ 63 cm and then totaled.

$$ED = SE \times PF \times F$$

where, PF = proportion of females; F = fecundity at size

An estimate of fecundity was obtained from the relationship derived in 1987 (October 27-30) from ripe salmon (Dempson et al. 1987):

$$\text{Fecundity} = 0.1988(\text{fork length, cm})^{2.3942} \qquad (r^2 = 0.48,\ P < 0.001)$$

where fork length was the mean length of female salmon < 63 cm. For 1999, the mean length and proportion of females from all years were used ($\bar{x}$ = 50.8 cm; N = 1236, and includes repeat spawning females < 63 cm; percentage female was 78%, N = 1579). These are the same values used since 1997.

An estimate of the egg deposition from salmon ≥ 63 cm in size was obtained using the same length-fecundity relationship for salmon < 63 cm, with the same percent females (71%) as used in past years (Dempson et al. 1998, 1999) but with mean size length data updated using the mean size of all large salmon sampled (69.1 cm, N = 151).

The **Management Target** has been maintained as in past years at **7.8 million eggs**. This was equivalent to about 4000 salmon < 63 cm in size.

In order to compare correctly and evaluate Conne River against other Newfoundland salmon rivers for which stock assessments are done, a corresponding **conservation spawning (egg) requirement (ER)** was been calculated. The calculation follows methods summarized in O'Connell and Dempson (1995) for average potential smolt production:

fluvial habitat	=	13180 units	@ 3 smolt/unit
lacustrine habitat	=	3187 hectares	@ 7 smolt/unit

Corresponding egg deposition requirements were derived using egg-to-smolt survival rates of 0.0125 and 0.019 for fluvial and lacustrine habitats, respectively. The **conservation spawning (egg) requirement** then, equals **4,337,358** eggs versus 7.8 million as a **Management Target**.

The equivalent total number of spawners (TNS) associated with the **conservation spawning (egg) requirement** has not changed and was calculated as follows:

$$TNS = \frac{ER}{[(PS \times PF_f \times F_f)]}$$

where,

PS = proportion small salmon (< 63 cm) in TRR, 1992-96 ($\bar{x}$ = 0.958)
PF_s = proportion female small salmon, 1992-96 ($\bar{x}$ = 0.769)
F_s = fecundity of small salmon at size ($\bar{x}$ length, 1992-96 = 50.5 cm, = 2379)

Thus, TNS = 2475 small salmon; large salmon are considered a buffer to spawning requirements.

5. Net-marked and escaped farmed Atlantic salmon

Surveys of net-marked salmon returning to Conne River were carried out from June 7 - July 20, 1999, but only on those fish clearly observed in the fish counting fence trap. Similarly, salmon observed in the counting fence trap showing characteristic 'farmed fish' appearance (fin size, shape and form, body shape and pigmentation) are noted and removed from the river. Identity of these 'suspect' fish are subsequently confirmed by examination of scale circuli characteristics. **Note, given that salmon can pass freely through an opening in the fish counting fence used in conjunction with operation of the video camera system, not all escaped farmed salmon (or rainbow trout) are removed from the Conne River system.** In addition, examination of scales obtained from sampling salmon throughout the run are used in a retrospective manner to infer the presence of escaped farmed salmon in Conne River.

6. Smolt production

A mark-recapture study was carried out to estimate the smolt production in 1999. The study was similar to those carried out from 1987-98, the design of which is summarized in Dempson and Stansbury (1991) and uses the estimator described in Schwarz and Dempson (1994). Since 1995, the downstream smolt trap has been monitored 24 hours of the day.

During 1999, 2179 smolts were tagged and released at the upstream partial counting fence site (Fig. 1). At the downstream recapture site, 7545 smolts were caught including 258 tagged smolts.

Results and Discussion

1. Landings of Atlantic salmon

Landings in the recreational fishery are summarized in Table 2. Harvest of over 2000 small salmon have been reported in some past years. As indicated earlier, there was no recreational fishery at Conne River in 1999. We note that in past years, angling exploitation rates have varied from 0.181 to 0.285 (Dempson et al. 1994).

Native food fishery catches are also summarized in Table 2. The highest catch occurred in 1990. There was no First Peoples' food fishery for Atlantic salmon in 1999.

2. Environmental conditions

Mean air temperature for the month of April was the second warmest since 1989, while the average May air temperature was the warmest during the period of operation (1986 - 1999). Similarly, the air temperature index for the period April 1 to May 15, was the warmest since 1987 (Fig. 3b) and was the third warmest overall. The first day with mean daily air temperatures of over 10° C in 1999 was May 3. Water temperatures (Fig. 2) similarly warmed up early and contributed to an earlier smolt run. The first day when the average daily water temperature exceeded 10°C (lower fish counting fence - Hugrun thermograph) in 1999 was May 4.

	Mean air temperature °C				Median day of smolt run
Year	April	May	April 1 - May 15	April 16 - 30	Timing
1986	5.11	7.70	5.60	8.51	-
1987	4.11	8.15	5.48	4.37	131
1988	3.18	10.08	4.77	3.55	136
1989	2.69	8.90	4.08	3.01	138
1990	2.28	6.36	3.46	2.72	138
1991	1.16	5.95	2.87	3.25	141
1992	0.36	7.77	2.36	0.67	145
1993	1.49	6.87	2.34	3.35	143
1994	1.17	6.21	2.69	2.28	142
1995	0.49	5.56	1.80	2.54	139
1996	3.09	5.82	3.69	5.02	124
1997	-0.36	5.87	1.59	0.43	146
1998	2.08	8.23	4.31	3.34	130
1999	2.56	10.46	4.86	3.39	126
2000	2.42		3.04	2.17	

Water temperatures increased over the summer with the warmest temperatures occurring in the latter part of July and in early August (Fig. 2). During the period June 1 – August 31, mean daily water temperature exceeded 20 °C on 30 occasions (Fig. 2), while doing so 29 times in 1998. In contrast, average daily water temperatures exceeding 20°C during the above interval occurred only 10 times in 1997. The maximum water temperature recorded in 1999 was on August 3 (26.6 °C), while maximum temperatures ≥ 25°C were recorded on only 2 days in (Aug 3, Aug 5).

High water levels occurred in mid- and late April and again in mid-August (Fig. 2).

3. Biological characteristics

Adult samples

Table 3a summarizes annual biological characteristic data of Atlantic salmon from Conne River, 1986-1999. Mean weight of 1SW salmon in 1994 and 1995 is lower by comparison with earlier years. This may have been because measurements were taken from salmon maintained in cages for brood stock and were recorded in September rather than in June or July as in past years.

Repeat spawning salmon are separated into consecutive and alternate categories. Consecutive spawners are typically less than 63 cm in fork length ($\bar{x}$ = 579 mm, Table 3) while alternate spawners average 696 mm in length (Table 3a) (Fig. 4). As acknowledged in past reports, not all size classes of fish can be sampled representatively. However, with respect to salmon less than 63 cm in length, only 162 (7.0%) out of 2319 samples at Conne River were either consecutive (N = 160) or alternate (N = 2) spawning fish. Length-frequency distributions of 1SW, 2SW, consecutive, and alternate spawners sampled at Conne River are illustrated in Figure 4. Biological characteristics of fish separated by life-history groups for small and large salmon is shown in Table 3b. Large salmon are primarily alternate spawners.

Biological characteristics of Atlantic salmon captured in the aboriginal food fishery are presented in Table 4.

Survival of repeat spawning salmon has increased substantially since the mid 1990's (Table 5). The most accurate information is derived from using consecutive spawning salmon from within the small size category only. Using these data, average survival has increased from 2.33% from 1986-90, to 16.85% for the past four years (1995-98).

O'Connell et al. (1997) recently examined inter-annual variation in fecundity for a variety of Newfoundland salmon rivers, including Conne River. Data (N = 459) from small salmon at Conne River were available from six years (1986 - 1988, 1990 - 1992) and were expressed in terms of number of eggs per female, as well as relative fecundity in terms of weight and length (Table 6). It was noted that there was a substantial decline in fecundity from 1988 to 1992 at Conne River. As indicated in Table 6, following the low fecundity values during the early 1990's, fecundity in 1997 was the highest recorded. No additional information has been obtained in 1998 or 1999.

Smolt samples

Smolt condition (Fulton's condition factor) has ranged from a high of 0.984 in 1988 to a low of 0.893 in 1992 (Fig. 3a). Smolt condition in 1999 (0.967) was above the long term average condition over all years ($\bar{x}$ = 0.937; 1986-99). Previously, it was noted that years in which smolts had a higher condition were often those that were associated with warmer spring

temperatures (Fig. 3c). There was also an indication that smolt condition was associated with subsequent sea survival, as higher survival of smolts often occurred in years where condition was greater (Fig. 3d). The lower condition of smolts in 1997 was consistent with reduced survival that occurred with returning salmon in 1998. Condition of 1998 smolts was similar to the average over all years average (0.940) but survival was correspondingly low.

Farmed (hatchery) salmon present in 1999

There was only (1) salmon identified as escaped farmed fish from a post-season analysis of scale characteristics out of 174 adult salmon sampled in 1999. No salmon of farmed origin were identified in 257 smolts sampled in 1999.

Run timing

Figure 5 illustrates the run timing of smolts and adult small salmon at Conne River. Variability in run timing is apparent for both groups with up to a 21 day difference in the 25th percentile of the run of smolts and 15 day difference in timing of small salmon returns. Median dates of the smolt run were typically later (7 days) during 1991- 1994 (May 21) in comparison with the pre-1990 period (May 14); the earliest smolt run occurred in 1996 while the latest run was in 1997. Smolt run timing in 1999 was the second earliest recorded to date (Fig. 5). The distributions of each of the annual smolt runs are shown in Figure 6. Median run timing of small salmon was the earliest recorded (Fig. 5).

Rainbow (steelhead) trout and farmed brook trout

Updated records on the numbers of rainbow (steelhead) trout encountered at Conne River from all years (1997 – 1999) are provided in Table 7a. Note that it is not possible to provide an absolute number of rainbow that have been observed in Conne River. This is because observations from snorkelling surveys, which occur at periodic intervals over the summer, are included and thus some trout are likely counted on more than one occasion (i.e. double counted) during successive surveys. Rainbow trout that are captured in the fish counting fence trap are removed from the river and sampled. As noted earlier, rainbow trout can pass freely through the opening in the fish counting fence where the video camera system is installed. Records of rainbow trout caught during a survey of the lower Conne River carried out March 24-25, 1999, are summarized in Table 7b.

Several escaped farmed brook trout were also encountered in Conne River during 1999. Two specimens (41.0 and 43.0 cm in length) were caught during the March 1999 survey of the lower portion of Conne River (Table 7b), while others were captured in either the smolt or adult fish counting fence trap during the spring or summer. These fish varied in length from 30.5 to 41.0 cm.

Aboriginal Guardian patrols: February – November 1999

Data obtained from weekly reports provide **minimum** accounts of numbers of people observed fishing and corresponding numbers of fish captured. Data are considered **minimum** as surveys were not carried out at each location during an entire day, but rather represent 'spot' observations during the particular period that Guardians happened to visit any specific site.

A summary of the patrol reports stratified by standard weeks is provided in Table 7c. Fishing activity was highest during February and March, with activity again increasing during October. Most fishing activity was reported at the Causeway-Tailrace and Vyse Cove areas although rainbow trout were also reported being captured at St. Alban's, Little River, Swanger's Cove, and lower Conne River (Table 7c). Overall, more than 3600 rainbow trout were reported caught.

4. Estimated returns, sea survival and spawning escapement

There were 2357 salmon < 63 cm and 241 salmon ≥ 63 cm counted at the fish counting fence on Conne River in 1999 (Tables 8 and 9). This represents a decrease of 20% in the number of small salmon by comparison with 1998 while the number of large salmon decreased by 18%; the count of large salmon, however, was still the second highest since 1990. The single largest daily run occurred on June 18 (244 small salmon) (Fig. 7) with 95% of the run of small salmon in 1999 complete by July 1. The distributions of past annual small salmon counts are also shown in Figure 7.

Partitioning the count of salmon among the various ways fish were enumerated in 1999 is as follows:

	Small Salmon		Large Salmon	
	N	%	N	%
Fence opening	0	0	0	0
Counting fence trap	1042	44	148	62
Video camera chamber	1315	56	93	38
Total	2357	100	241	100

With respect to the video camera system, salmon again generally migrated all night long. During 1999, the period from 2230 to 0229 hours accounted for 49% of the total, somewhat less than in past years. A total of 1359 fish were associated with time of fish passage during the evening or throughout the night as follows: (remaining salmon enumerated by video camera outside of the hours shown below)

Time (hours)	Number of fish	%
2030 - 2229	223	19
2230 - 0029	255	22
0030 - 0229	318	27
0230 - 0429	279	24
0430 - 0900	100	8
Total	1175	100

Total returns (Fig. 8) of adult salmon to Conne River in 1999 are summarized in Tables 8 and 9 for small and large salmon, respectively.

Total returns of small salmon (2358) were 20% lower than in 1998, and have now fallen 47% since 1996. Total returns of large salmon (241) were 18% less than 1998. Greater numbers of large salmon in recent years, by comparison with 1991 - 1997, can be attributed to the increased survival of repeat spawning salmon at Conne River in recent years (Table 5).

Sea survival

Sea survival from smolts to small salmon has varied from 2.7 to 10.2% (Table 10). Survival had increased from 2.7% (2.6-3.0%) in 1994 (adult return year) to 7.2% (6.4-8.3%) in 1996 but has remained between 2.9 and 3.4% over the past three years 3.4% (Fig. 8, Table 10), although marine survival increased in 1999 (3.4%) over that recorded in 1998 (2.9%). Corresponding sea survival to 1SW salmon also increased over the previous year, but remains anomalously low.

Spawning escapement

Potential spawning escapement in 1999 was estimated to be 2349 small salmon and 240 large salmon (Tables 8 and 9). Mean number of eggs per female for the wild salmon was 2413 using average size data of females for all years.

small salmon = 4.42153 million eggs
large salmon = 0.85894 million eggs

for a total egg deposition of 5.28 million, representing 68% of the current **Management Target** or 122% of the **conservation spawning (egg) requirement** (Table 9). Note, some values in Table 8 and 9 may have changed slightly as a result of updating biological characteristic information on small and large salmon.

Egg-to-smolt survival

Estimates of egg-to-smolt survival are now available for eight year-classes (1986 to 1993); a ninth year-class (1994) is complete only to age 4 smolts in 1999. These values, by year-class, are:

Year-class (eggs)	Estimated egg Deposition	Smolt Production	Survival (%)	Number of eggs per 100 m²
1986	11384887	57499	0.51	864
1987	17097439	76211	0.45	1297
1988	12379696	65237	0.53	939
1989	8012933	55006	0.69	608
1990	8714995	68021	0.78	661
1991	4012578	58776	1.46	304
1992	3755984	95707	2.55	285
1993	4760786	98561	2.07	361
1994	3116682	(65653)[1]	(2.11)	236
1995	6368593			483
1996	8859057			672
1997	5437344			413
1998	6513054			494
1999	5280478			401

[1] to age 4 smolts in 1999

Egg-to-smolt survival, has increased three-fold from the average of the 1986 to 1990 values (mean = 0.59%) to those obtained since 1991. The dramatic increase in the egg-to-smolt survival coincided with the first of several successive years in which the egg depositions were below the Management Target of 7.8 million eggs and has maintained this pattern (Fig. 9). We note that with the higher egg deposition that occurred again in 1995, egg-to-smolt survival will again be considerably lower. Smolts produced to date from the 1995 year class are now complete to age 3; egg-to-smolt survival is 0.81% so far, and will likely be about half that which has occurred from the 1992-1994 year classes. As stated last year (Dempson et al. 1999), it may be prudent at that time to review the Management Target for Conne River.

5. Net-marked salmon

The following summarizes observations of net marked fish at Conne River during 1999.

Date	Number of fish observed	Number scarred	Percent Scarred
June 7-16	260	8	3.1
June 17-21	103	7	6.8
June 22-26	123	5	4.1
June 27-July 1	47	2	4.3
July 2-6	8	0	0
July 7-11	10	0	0
July 13-20	5	0	0
Total	556	22	4.0

Numbers of net marked salmon varied on each occasion with no apparent increasing or decreasing trend. Results from 1999 are similar to those of 1998, and are among the lowest recorded (1994 = 18.6%; 1995 = 7.1%; 1996 = 6.2%; 1997 = 7.2%; 1998 = 3.7%).

6. Smolt production

The estimated number of smolts in 1999 was 63,658 (95% confidence limit = 53305-74011) (Table 10). Smolt production has now declined by 37% from the peak run in 1997, but is similar to the average production estimated from 1987 to 1995 (65,897 smolts). The number of smolts and percentage in each age group is summarized in Table 11. Numbers have been updated from past reports based on a reanalysis of biological characteristic data. Based upon the point estimate of the number of smolts that migrated in 1999 (63,658), a marine survival rate of 3.9% is required in order for the conservation requirement to be attained while a marine survival of 6.3% will need to occur in order for the Management Target to be achieved in 2000. Both values are higher than that observed during the past three years.

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Table 1. Summary of dates of operation for downstream smolt mark-recapture studies, and upstream adult salmon counts at Conne River, Newfoundland, 1986 - 1999.

Year	Smolt mark-recapture studies		Adult salmon counts	
	Start	Finish	Start	Finish
1986			May 12	Sept 10
1987	April 26	June 16	May 18	Sept 8
1988	May 9	June 14	May 21	Aug 29
1989	May 9	June 15	May 20	Aug 28
1990	May 3	June 20	May 23	Aug 6
1991	May 3	June 16	May 26	Aug 18
1992	May 10	June 15	May 26	Aug 10
1993	May 9	June 14	May 28	July 31
1994	April 28	June 18	June 1	Sept 25
1995	May 2	June 8	May 30	Oct 16
1996	April 26	June 11	May 21	Sept 23
1997	May 15	June 15	May 29	Sept 4
1998	April 30	June 5	May 19	Sept 20
1999	April 21	June 8	May 16	Sept 13

Table 2. Atlantic salmon landings (in numbers of fish) in the recreational fishery, 1974-1999, and in the native food fishery, 1986-1999, at Conne River, Newfoundland. Note that the recreational fishery was closed from 1993 - 1996 and again in 1998-1999, while the food fishery was closed from 1994 - 1996, and in 1998-1999.

	Recreational Fishery				Native Food Fishery			
	Effort	Salmon catch				Salmon catch		
Year	rod-days	Small	Large	Total	Quota	Small	Large	Total
1974	4033	1988	17	2005				
1975	3800	1903	17	1920				
1976	3894	1931	27	1958				
1977	3375	1665	5	1670				
1978	3122	1735	7	1742				
1979	2147	1010	0	1010				
1980	3512	2238	14	2252				
1981	5029	2691	2	2693				
1982	5268	3302	24	3326				
1983	6972	2192	21	2213				
1984	6709	2343	0	2343				
1985	5202	2729	0	2729				
1986	6038	2060	0	2060	1200	519	3	522
1987	4979	1598	0	1598	1200	18	0	18
1988	5504	1544	0	1544	1200	607	2	609
1989	4414	1036	0	1036	1200	381	1	382
1990	2740	757	0	767	1200	948*	11	11
1991	679	108	0	108	1200	281	3	284
1992	1499	329	0	329	1200	483	5	488
1993	0	0	0	0	500	417	3	420
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997		197	0	197	600	514	1	515
1998	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0

* Total for 1990 does not include approximately 50 fish found dead and partially destroyed in traps.
Quotas of 100 and 330 small salmon were in effect for the recreational fishery in 1991 and 1992, respectively.
Initial food fishery allocation pending an inseason stock status review was for 600 small salmon.

Table 3a. Summary of biological characteristics for Atlantic salmon samples from Conne River, Newfoundland (SFA 11), 1986-1999.

Lifestage	Year	Fork length (mm)					Whole weight (g)					River age (y)					Sex Ratio	
		N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	% female
Smolt	1986	145	153	12.0	125	210	0					145	3.25	0.48	2	5	0	
	1987	271	144	16.5	106	196	271	29.1	9.9	11.5	73.8	271	3.32	0.54	2	5	270	77
	1988	328	147	15.7	102	201	328	32.3	10.4	12.4	78.8	328	3.41	0.51	3	5	327	73
	1989	288	152	21.3	98	238	288	35.0	14.0	9.8	123.2	288	3.25	0.53	2	5	288	79
	1990	271	148	21.2	100	253	271	30.5	13.1	10.3	122.8	271	3.29	0.49	2	5	271	74
	1991	246	153	19.9	104	244	246	33.5	13.6	12.6	112.5	246	3.19	0.44	2	5	245	66
	1992	169	149	15.6	116	189	169	30.1	8.9	14.9	59.2	169	3.28	0.51	2	5	169	71
	1993	246	149	16.5	114	198	246	31.6	10.3	15.7	71.7	246	3.26	0.45	3	5	246	67
	1994	208	148	15.1	116	190	208	29.6	8.3	16.0	59.2	208	3.20	0.41	2	4	208	74
	1995	249	143	15.2	103	179	249	28.6	8.3	10.3	50.6	249	3.31	0.51	2	5	249	73
	1996	243	151	16.0	102	224	243	32.9	10.2	16.3	93.8	243	3.16	0.47	2	5	243	73
	1997	380	148	16.2	114	233	380	30.9	11.0	14.9	105.8	380	3.21	0.45	2	5	380	75
	1998	282	147	14.8	110	233	282	30.8	9.4	12.4	106.0	282	3.23	0.48	2	5	282	71
	1999	257	148	15.3	110	188	257	32.1	9.2	13.5	62.8	257	3.19	0.41	2	4	257	74
TOTAL		3583	148	17.0	98	253	3436	31.4	10.9	9.8	123.2	3583	3.26	0.48	2	5	3435	73
1 SW	1986	357	506	23.0	440	570	357	1451	220.4	900	2900	357	3.36	0.57	2	5	356	76
	1987	373	509	23.3	430	580	373	1492	247.5	600	2600	373	3.18	0.48	2	5	352	79
	1988	267	506	26.1	440	600	267	1352	226.5	1000	2200	267	3.14	0.42	2	4	261	80
	1989	140	512	23.3	460	580	140	1411	201.7	1000	2000	140	3.18	0.50	2	5	135	79
	1990	174	508	23.4	449	575	142	1454	184.4	1100	2000	174	3.27	0.52	2	5	141	81
	1991	39	514	22.8	455	552	34	1362	172.4	1000	1700	39	3.18	0.39	3	4	33	70
	1992	77	505	22.4	453	580	36	1363	276.1	900	2000	77	3.18	0.53	2	5	43	79
	1993	39	513	30.8	475	620	0					39	3.05	0.32	2	4	0	
	1994 *	73	510	25.8	405	580	69	1272	193.9	800	1800	73	3.12	0.44	1	4	71	75
	1995 *	111	498	24.8	433	573	107	1144	184.4	800	1700	111	3.14	0.42	2	5	105	77
	1996	72	518	21.8	475	573	19	1523	219.1	1160	1920	72	3.22	0.51	2	5	2	100
	1997	163	514	22.1	460	590	39	1467	321.5	700	2000	163	3.24	0.48	2	5	39	82
	1998	135	502	22.3	420	560	0					135	3.08	0.42	2	4	0	
	1999	112	513	21.6	450	580	1	2300		2300	2300	112	3.15	0.43	2	4		
TOTAL		2157	508	23.9	405	620	1609	1408	242.1	600	2900	2157	3.21	0.49	1	5	1538	78

* Samples of 1SW salmon in 1994 and 1995 were obtained from fish held for brood stock. Thus fish were sampled in September in each of these years.

Table 3a. (Continued) Summary of biological characteristics for Atlantic salmon samples from Conne River, Newfoundland (SFA 11), 1986-1999.

Lifestage	Year	Fork length (mm)					Whole weight (g)					River age (y)					Sex Ratio	
		N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	% female
2 SW	1986	1	630				1	2600				1	3.00				1	100
	1989	2	685	21.2	650	680	1	2700				2	3.50	0.71	3	4	1	100
	1992	1	650				1	2700				1	4.00				0	
	1994	1	700				0					1	3.00				0	
	1995	2	735	49.5	700	770	0					2	3.00	0.00	3	3	0	
	1996	2	665	14.1	655	675	0					2	2.50	0.71	2	3	0	
	1997	1	740				0					1	3.00				0	
TOTAL		10	685	43.7	630	770	3	2667	57.5	2600	2700	10	3.10	0.57	2	4	2	100
Consecutive Spawning Grilse																		
	1986	1	560				1	1800				1	3.00				1	100
	1987	6	528	29.4	485	576	6	1578	351.6	1070	2100	6	3.17	0.75	2	4	5	100
	1988	5	556	24.1	530	590	5	1640	260.8	1500	2100	5	2.80	0.84	2	4	5	40
	1989	6	575	23.5	550	610	6	1767	233.8	1500	2000	6	3.00	0.00	3	3	6	50
	1990	3	564	51.4	505	601	0					3	3.33	0.58	3	4	0	
	1991	4	566	49.9	548	659	1	1400				4	3.50	0.58	3	4	1	100
	1992	8	561	43.6	530	660	0					8	3.50	0.53	3	4	0	
	1993	3	617	58.9	570	680	0					3	2.67	1.15	2	4	0	
	1994	15	564	36.1	510	640	14	1714	455.5	1200	2900	15	3.20	0.56	2	4	15	73
	1995	2	547	3.5	544	549	2	1500	141.4	1400	1600	2	3.00	0.00	3	3	2	100
	1996	19	572	60.8	505	795	0					19	3.16	0.37	3	4	2	50
	1997	52	582	37.0	510	685	0					52	3.21	0.50	2	4	0	
	1998	29	591	45.8	490	700	0					29	3.28	0.45	3	4	0	
	1999	33	587	59.5	480	730	2	2450	70.7	2400	2500	33	3.27	0.45	3	4	1	100
TOTAL		186	579	46.8	480	795	37	1713	384.5	1070	2900	186	3.22	0.51	2	4	36	71
Alternate Spawning Grilse																		
	1986	1	600				1	2400				1	3.00				1	100
	1989	13	683	18.9	660	710	2	3350	212.1	3200	3500	13	3.08	0.28	3	4	2	100
	1991	2	700	29.0	679	720	0					2	3.50	0.71	3	4	0	
	1992	8	682	44.4	630	770	0					8	2.88	0.35	2	3	1	100
	1993	6	675	35.1	640	710	0					6	3.33	0.52	3	4	0	
	1994	3	703	45.1	660	750	0					3	3.00	0.00	3	3	0	
	1995	5	730	29.2	710	780	0					5	3.00	0.00	3	3	0	
	1996	4	710	21.2	695	740	0					4	3.25	0.50	3	4	0	
	1997	19	702	30.9	655	780	0					19	3.21	0.42	3	4	0	
	1998	27	691	32.1	625	760	0					27	3.07	0.27	3	4	0	
	1999	29	707	30.2	660	790	0					29	3.21	0.41	3	4	0	
TOTAL		117	696	33.5	600	790	3	3033	568.6	2400	3500	117	3.14	0.37	2	4	4	100

Table 3b. Summary of biological characteristic information by life-history groups for small and large fish with corresponding notation for Conne River Atlantic salmon, 1986 - 1999.

Life-history group	Notation	Notation N	Notation Percent	Fork length (mm) N	Fork length (mm) Mean	Fork length (mm) SD	Fork length (mm) Min	Fork length (mm) Max	Whole weight (g) N	Whole weight (g) Mean	Whole weight (g) SD	Whole weight (g) Min	Whole weight (g) Max
Small salmon (< 630 mm for length; N = 2319)													
Virgin grilse	1.1	1	0.04	1	531				1	1300			
	2.1	60	2.59	60	501	24.3	440	540	41	1337	242.6	600	1900
	3.1	1588	68.48	1588	508	23.7	405	610	1164	1401	237.8	700	2600
	4.1	493	21.26	493	511	24.3	420	620	390	1436	252.7	800	2900
	5.1	15	0.65	15	522	26.8	490	590	13	1460	229.8	1000	1800
Consecutive spawning grilse	2.1.SM	5	0.22	5	552	20.5	520	570	3	1633	152.8	1500	1800
	3.1.SM	93	4.01	93	562	31.3	490	625	23	1670	299.1	1300	2400
	3.1.SM.SM	19	0.82	19	598	22.2	560	625	3	2100	360.6	1800	2500
	4.1.SM	37	1.60	37	557	30	480	610	6	1428	242.5	1070	1700
	4.1.SM.SM	6	0.26	6	583	28.1	550	625	1	2300			
Alternate spawning grilse	3.1.SM.1	2	0.09	2	613	17.7	600	625	1	2400			
Large salmon (>= 630 mm for length; N = 151)													
Virgin 2SW	2.2	1	0.66	1	675								
	3.2	7	4.64	7	685	53.0	630	770	3	2667	57.7	2600	2700
	4.2	2	1.32	2	690	14.1	680	700					
Consecutive spawning large	2.1.SM.SM	2	1.32	2	670	14.1	660	680					
	2.1.SM.SM.SM.SM	1	0.66	1	640								
	3.1.SM	1	0.66	1	630								
	3.1.SM.SM	11	7.28	11	659	46.8	630	795					
	3.1.SM.SM.SM	4	2.65	4	684	39.4	640	730					
	3.1.SM.SM.SM.SM	2	1.32	2	690	0.0	690	690					
	4.1.SM.SM	4	2.65	4	648	9.6	640	660					
	4.1.SM.SM.SM	1	0.66	1	650								
Alternate spawning large	2.1.SM.1	1	0.66	1	630								
	3.1.SM.1	94	62.25	94	697	29.9	640	780	2	3350	212.1	3200	3500
	3.1.SM.SM.1 *	2	1.32	2	730	42.4	700	760					
	3.1.SM.SM.SM.1 *	1	0.66	1	680								
	4.1.SM.1	17	11.26	17	704	37.9	640	790					

* These fish originally spawned consecutively, then remained at sea for a full year to return as an alternate spawner. These cases all occurred in salmon that returned in 1998.

Table 4. Summary of biological characteristics for Atlantic salmon samples from the Conne River aboriginal food fishery, 1988, 1992-93, and 1997.

Lifestage	Year	Fork length (mm)					Whole weight (g)					River age (y)					Sex Ratio	
		N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	% female
1 SW	1988	527	503	25.0	408	585	469	1397	219.0	600	2100	527	3.17	0.40	2	5	516	78
	1992	208	516	20.3	470	580	205	1389	178.6	1000	2000	208	3.07	0.44	2	5	206	67
	1993	253	504	24.3	430	640	253	1347	214.1	900	2400	253	3.08	0.39	1	4	253	67
	1997	472	529	23.6	460	610	472	1774	279.8	1000	2900	472	3.21	0.49	2	5	472	71
TOTAL		1460	513	26.5	408	640	1419	1512	299.2	600	2900	1460	3.15	0.44	1	5	1447	72
2 SW	1988	1	670				1	3300				1	4.00				1	100
	1992	1	690				1	2200				1	3.00				1	100
TOTAL		2	680	14.1	670	690	2	2750	777.8	2200	3300	2	3.50	0.71	3	4	2	100
Consecutive Spawning Grilse																		
	1988	11	591	58.6	518	733	9	2278	767.8	1300	3800	11	3.45	0.52	3	4	11	91
	1997	3	527	41.6	480	560	3	1367	152.8	1200	1500	3	4.00	0.00	4	4	3	100
TOTAL		14	578	60.6	480	733	12	2050	776.4	1200	3800	14	3.57	0.51	3	4	14	93
Alternate Spawning Grilse																		
	1992	2	685	7.1	680	670	2	3650	353.6	3400	3900	2	3.50	0.71	3	4	2	100
	1993	2	685	7.1	680	690	2	3550	212.1	3400	3700	2	3.00	0.00	3	3	2	100
	1997	1	690				1	4400				1	3.00				1	100
TOTAL		5	678	13	680	690	5	3760	415.9	3400	4400	5	3.20	0.45	3	4	5	100

Table 5. Estimated numbers of small and large Conne River Atlantic salmon partitioned by life stage, and the percentage of 1SW small salmon that survive to spawn in year i+1 as a small consecutive spawner, the last column includes the contribution of large salmon from year i - 2 only, in deriving the estimated survival of repeat spawners. Bracketed value for 1998 is preliminary pending alternate salmon spawners in 2000.

	Small salmon						Large salmon						
			Previous spawners						Previous spawners				
			Consecutive		Alternate	Survival of 1SW fish to consecutive spawners (%)			Consecutive	Alternate			% Survival of 1SW salmon to consecutive or alternate spawners
Year	Total	1SW	(from year i - 1)	(from year i - 2)	(from year i - 2)	in year i+1	Total	2SW	(from year i - 2)	(from year i - 2)	(from year i - 3)	Other	(small and large salmon from year i - 2 only)
1986	8302	8258	0	23	23	1.83	412	28	46	251	49	38	5.50
1987	10155	10004	151	0	0	1.40	516	34	58	314	62	48	3.71
1988	7627	7487	140	0	0	2.72	420	28	47	256	50	39	6.32
1989	4968	4764	204	0	0	1.91	320	21	36	195	38	30	3.25
1990	5368	5277	91	0	0	3.77	372	25	42	227	44	34	5.95
1991	2411	2164	199	48	0	9.66	89	6	10	54	11	8	12.99
1992	2523	2264	209	50	0	9.89	159	10	18	97	19	15	13.07
1993	2703	2426	224	53	0	5.23	100	7	11	61	12	9	8.53
1994	1533	1376	127	30	0	4.51	100	7	11	61	12	9	13.88
1995	3502	3440	62	0	0	24.16	110	7	13	67	13	10	28.05
1996	4154	3323	831	0	0	16.49	179	12	20	109	21	17	22.90
1997	3200	2484	548	168	0	14.08	185	12	21	113	22	17	21.10
1998	2931	2489	350	74	18	12.66	295	20	33	180	35	27	(12.98)
1999	2358	1956	315	87	0		241	16	27	147	29	22	

* example of survival calculation from 8258 1SW salmon in 1986 that would include large salmon:
101 consecutive spawners from 1987 + 46 (large) consecutive spawners from 1988 + 256 (large) alternate spawners
from 1986: = 464/8258 * 100 = 5.50%
1SW data for 1998 have been adjusted for the wild-aquacultured salmon that returned that year (4440 - 268 = 4154 small salmon)
For large salmon, the average breakdown over all years (1986-1998) has been used to apportion fish into respective life history classes, of which only the most common are illustrated here, with other combinations listed as 'other'.

Table 6. Mean number of eggs per female, length, weight data, and relative fecundity of Conne River Atlantic salmon.

Year		N	Number of eggs per female				Length (cm)				Weight (kg)				Relative Fecundity	
			Mean	STD	Min	Max	Mean	STD	Min	Max	Mean	STD	Min	Max	No. of eggs per cm	No. of eggs per kg
1987	*	30	2430	403	1796	3454	50.7	2.37	46.0	56.0	1.28	0.17	1.02	1.74	47.8	1907
1986		102	3494	682	1450	5590	50.9	2.37	45.0	56.0	1.48	0.23	1.00	2.90	68.7	2367
1987		136	3424	635	1287	5476	51.1	2.36	42.0	57.6	1.45	0.25	1.00	2.60	67.0	2364
1988		85	3196	568	2111	5054	50.2	2.50	46.0	60.0	1.35	0.24	1.00	2.20	63.7	2366
1990		93	2245	575	703	3544	51.1	2.09	46.0	57.0	1.45	0.18	1.10	2.00	44.0	1545
1991		22	2772	1241	595	5010	51.7	2.01	47.0	55.2	1.35	0.15	1.00	1.60	53.6	2046
1992		21	1768	498	1009	2545	50.6	2.15	45.3	56.2	1.38	0.25	0.90	1.90	35.0	1278
1997		33	3627	459	2929	5158	51.6	2.29	46.0	57.5	1.45	0.33	0.70	2.00	70.3	2504
Years Combined	**	492	3090	845	595	5590	50.9	2.33	42.0	60.0	1.43	0.24	0.70	2.90	60.7	2159

* These 1987 data were obtained from ripe salmon sampled at the end of October. For other years, samples were obtained primarily in June and July.
** Information from years combined does not include data from ripe salmon sampled in 1987.

Table 7a. Summary of rainbow trout occurrences and captures at Conne River, 1997 - 1999, with corresponding size data where available. Information from past years has been summarized in previous research assessment documents (Dempson et al. 1999). for completeness.

Year	Date	Location/gear	Length (mm)	Whole weight (g)
1997	May 18	Downstream trap	546	
	May 23	Downstream trap		
	June 1	Downstream trap	170	
	June 3	Downstream trap	195	
	June 4	Downstream trap	405	
	June 17	Snorkling observation (N = 25)	150 - 500	
	June 26	Snorkling observation (N = 8)	200 - 400	
	July 1	Fence mortality	475	
	July 2	Snorkling observation (N = 15)	200 - 400	
	July 3	Upstream trap	540	
	July 9	Upstream trap	300	
	July 13	Snorkling observation (N = 3)	150 - 200	
	July 26	Snorkling observation (N = 10)	200 - 500	
	August 2	Fence mortality	520	
	August 7	Upstream trap	395	
1998	May 11	Downstream trap	385	
	May 20	Upstream trap	300 - 400	
	June 5	Upstream trap	435	
	June 25	Snorkling observation (N = 3)	250 - 350	
	July 5	Snorkling observation (N = 3)	150 - 200	
	July 7	Snorkling observation (N = 3)	150 - 400	
	July 9	Snorkling observation (N = 3)	150 - 200	
	July 9	Upstream trap	405	
	July 14	Snorkling observation (N = 2)	200 - 400	
	July 18	Snorkling observation (N = 7)	200 - 400	
1999	April 23	Snorkling observation (N = 5)	350 - 550	
	May 6	Angled in lower river (N = 3)		
	May 6	Angled in lower river	485	
	May 6	Angled in lower river	473	
	May 6	Angled in lower river	500	
	May 8	Angled in lower river (N = 4)		
	May 11	Angled in lower river (N = 8)	350 - 550	
	May 15	Snorkling observation (N = 15)	300 - 500	
	May 18	Upstream trap	385	
	May 18	Upstream trap	490	
	June 14	Upstream trap	450	
	June 16	Snorkling observation (N = 25)	200 - 400	
	June 22	Snorkling observation (N = 20)	200 - 400	
	June 27	Snorkling observation (N = 15)	200 - 400	
	July 1	Snorkling observation (N = 15)	200 - 450	
	July 17	Snorkling observation (N = 8)	300 - 500	
	July 18	Snorkling observation (N = 1)	~ 300	
	Aug 12	Snorkling observation (N = 12)	300 - 500	

Table 7b. Summary of escaped farmed salmonids captured in Conne River, March 24 - 25, 1999. All fish were caught by angling in the lower section of the river below Goodyears and Dashwood Steady. Gross examination of stomach contents are provided.

Species	Length (mm)	Whole weight (kg)	Sex	Stomach Contents
Rainbow	460	1.2	-	detritus
Rainbow	420	1.0	-	detritus
Rainbow	440	1.3	-	35 Caddis larvae
Rainbow	360	0.6	-	detritus
Rainbow	400	0.8	-	detritus
Rainbow	410	1.0	-	3 Caddis larvae and detritus
Rainbow	360	0.6	-	detritus
Rainbow	510	1.9	-	14 Caddis larvae
Rainbow	360	0.5	-	detritus
Salmon	480	1.3	Female *	detritus
Brook trout	410	1.0	Male *	detritus
Brook trout	430	0.9	Male *	detritus
Rainbow	320	0.5	-	detritus
Rainbow	370	0.6	-	detritus
Rainbow	550	2.0	-	small pebbles
Rainbow	550	2.3	-	pebbles and detritus

* The escaped farmed salmon and brook trout showed early indications of maturation

Table 7c. Summary of numbers of people observed fishing and corresponding numbers of rainbow trout and brook trout caught in the upper Bay d'Espoir and surrounding area by standard week, from February 1 - November 11 1999. Data were collected during patrols carried out by the Conne River Aboriginal Guardians. Areas left blank indicate no observed catch.

Date	Standard Week	Number of people fishing	Area patrolled	Number of fish caught		
				Rainbow trout	Brook trout	Sea Trout
Jan 29 - Feb 4	5	188	Causeway, Vyse Cove & Little R.			
		56	Ice fishing			
Feb 5 - 11	6	388	Causeway & Vyse Cove	280		
		21	Little River		148	
		25	Ice fishing			
Feb 12 - 18	7	183	Causeway & Vyse Cove	78		
		21	Causeway - Tailrace	4		
		33	Vyse Cove	26		
		23	St. Alban's	15		
		62	Conne	54		
		8	Ice fishing			
Feb 19 - 25	8	11	Causeway - Tailrace	3		
		57	Vyse Cove	30		
		20	Conne	24		
Feb 26 - Mar 4	9	113	Causeway - Tailrace	52	16	
		26	Vyse Cove	7	3	
		2	Conne	4	6	
		12	St. Alban's	9		
		0	Harbour Breton highway			
Mar 5 - 11	10	108	Causeway - Tailrace	68	15	
		5	Vyse Cove	4		
		4	Little River	4		25
		2	St. Alban's			
Mar 12 - 18	11	94	Causeway - Tailrace	56	1	
		2	Vyse Cove			
		10	Swanger's Cove (Bridge)	12	2	
		2	Conne River shoreline	1		
		16	Conne River (lower)	35	7	
Mar 19 - 25	12	83	Causeway - Tailrace	45	5	
		6	Vyse Cove	4		
		6	Conne	1		
Mar 26 - Apr 1	13	55	Causeway - Tailrace	14	1	
		25	Vyse Cove	40		2
		1	Swanger's Cove (Bridge)			
		8	St. Alban's			
		3	Head of Bay d'Espoir (along shore)			
		2	Southeast Bk			
		2	Morrisville area			
		21	Conne River (lower)	70		
Apr 2 - 8	14	22	Causeway - Tailrace	5		
		4	Conne River (lower)	12	1	
Subtotal		1710		937	205	27

Table 7c. Continued. Summary of numbers of people observed fishing and corresponding numbers of rainbow trout and brook trout caught in the upper Bay d'Espoir and surrounding area by standard week, from April 26 - November 11, 1999. Data were collected during patrols carried out by the Conne River Aboriginal Guardians. Areas left blank indicate no observed catch.

Date	Standard Week	Number of people fishing	Area patrolled	Number of fish caught		
				Rainbow trout	Brook trout	Sea Trout
Apr 23 - 29	17	1	Causeway			
Apr 30 - May 6	18	12	Causeway	5		
		5	Vyse Cove	53		
		2	Little River	10		
		4	Coastal - Bay d'Espoir			
May 7 - 13	19	1	Causeway			
		46	Vyse Cove	115		
		5	Conne River (lower section)	11		
May 14 - 20	20	14	Causeway	11		
		112	Vyse Cove	230		
		2	Conne River (lower section)	10		
May 21 - 27	21	12	Causeway	4		
		2	Tailrace			
		94	Vyse Cove	205		
May 28 - Jun 3	22	5	Causeway			
		85	Vyse Cove	286		
Jun 4 - 10	23	7	Causeway			2
		12	Tailrace	40		
		10	Vyse Cove	25		
Jul 2 - 8	27	7	Causeway	4	2	
		4	Tailrace		4	
		5	Vyse Cove	8		
Jul 9 - 15	28	16	Causeway		6	5
		29	Tailrace	9	7	1
		75	Vyse Cove	170		
Jul 16 - 22	29	24	Causeway	3	4	4
		38	Tailrace	4	24	
		79	Vyse Cove	160		
Jul 23 - 29	30	24	Causeway	6		3
		23	Tailrace	7	32	
		60	Vyse Cove	129		
Jul 30 - Aug 5	31	27	Causeway	8	2	
		24	Tailrace	8	28	
		64	Vyse Cove	129		
Aug 6 - 12	32	23	Causeway	6		4
		19	Tailrace	6	23	1
		49	Vyse Cove	90		
Subtotal		1021		1752	132	20

Table 7c Continued. Summary of numbers of people observed fishing and corresponding numbers of rainbow trout and brook trout caught in the upper Bay d'Espoir and surrounding area by standard week, from February 1 - December 23, 1999. Data were collected during patrols carried out by the Conne River Aboriginal Guardians. Areas left blank indicate no observed catch.

Date	Standard Week	Number of people fishing	Area patrolled	Number of fish caught		
				Rainbow trout	Brook trout	Sea Trout
Aug 13 - 19	33	17	Causeway	8	2	
		14	Tailrace	4	19	1
		43	Vyse Cove	70		
Aug 20 - 26	34	11	Causeway	5	8	
		18	Tailrace	12	14	
		23	Vyse Cove	39		
		2	Coastal - Bay d'Espoir			
Aug 27 - Sep 2	35	2	Causeway			
		3	Tailrace	1		
		1	Swanger's Cove (Bridge)			
Sep 3 - 9	36	4	Causeway	1		
		6	Tailrace			1
		4	Vyse Cove			
		36	St. Albans area			
		3	Conne River community			
Sep 17 - 23	38	3	Tailrace	4		
Sep 24 - 30	39	13	Causeway	38		
		36	Tailrace	95		
Oct 1 - 7	40	55	Causeway	74		
		97	Tailrace	130		
		2	Milltown	3		
Oct 8 - 14	41	27	Causeway	13		
		31	Tailrace	25		
		2	Milltown	1		
		4	Conne River - lower section	18		
		2	Conne River - shoreline	1		
		1	Conne Barasway	1		
		2	Little River	6		
Oct 15 - 21	42	29	Causeway	41		
		36	Tailrace	38		
		5	Head of Bay d'Espoir - shoreline	2		
		11	Area unspecified	3		
Oct 22 - 28	43	10	Causeway	14		
		16	Tailrace	10		
		2	Vyse Cove			
		63	Area unspecified	52		
Oct 29 - Nov 4	44	21	Causeway	4		
		26	Tailrace	15		
		2	Conne River - Community	5		
Nov 5 - 11	45	10	Causeway	7		
		22	Tailrace	14		
Subtotal		715		754	43	2

Table 7c Continued. Summary of numbers of people observed fishing and corresponding numbers of rainbow trout and brook trout caught in the upper Bay d'Espoir and surrounding area by standard week, from February 1 - December 23, 1999. Data were collected during patrols carried out by the Conne River Aboriginal Guardians. Areas left blank indicate no observed catch.

Date	Standard Week	Number of people fishing	Area patrolled	Number of fish caught		
				Rainbow trout	Brook trout	Sea Trout
Nov 12 - 18	46	9	Causeway	2		
		10	Tailrace	8		
		1	Vyse Cove			
		13	St. Albans area	7		
		3	Head of Bay d'Espoir	5		
		2	Millown	1		
		2	Conne River - lower section	1		
		3	Southeast Brook - Conne	1		
		2	Conne River - community			
		2	Little River			
Nov 19 - 25	47	16	Causeway	1		
		6	Tailrace	2		
		4	St. Albans area	2		
		2	Conne River - community			
Nov 26 - Dec 2	48	37	Causeway	19		
		26	Tailrace	22		
		15	St. Albans area	11		
		14	Head of Bay d'Espoir	4		
Dec 3 - 9	49	15	Causeway	5		
		8	Tailrace	4		
		13	St. Albans area	29		
		8	Head of Bay d'Espoir	8		
Dec 10 - 16	50	19	Causeway	7		
		7	Tailrace	2		
		13	St. Albans area	16		
		12	Head of Bay d'Espoir	14		
		2	Conne River - community	2		
		2	Little River	12		
Dec 17 - 23	51	26	Causeway	5		
		2	St. Albans area	2		
		2	Head of Bay d'Espoir	2		
Subtotal		296		194	0	0
Grand Total Feb 1- Dec 23		3742		3637	380	49

Table 8. Total estimated returns of small salmon to Conne River, Newfoundland, with a summary of mortalities and removals and estimated spawning escapement, 1986-1999.

	Year													
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Returns														
* Food Fishery (estuary)	766	451	506	317	831	234	403	347	0	0	0	428	0	0
Angling below fence				180	213	70	137	0	0	0	0	95	0	0
Mortalities below fence	21	17	3	2	3	2	0	1	0	2	4	1	0	1
Count at fence	7515	9287	7118	4469	4321	2086	1973	2355	1533	3500	4436	2676	2931	2357
Estimated count		400				19	10							
Total Returns	8302	10155	7627	4968	5368	2411	2523	2703	1533	3502	4440	3200	2931	2358
1 - Released at fence	7515	9687	7118	4469	4321	2105	1983	2355	1533	3500	4436	2676	2931	2357
Removals and mortalities														
Mortalities above fence/or in trap	27	21	7	4	2	5	8	2	5	7	9	5	5	8
Angling above fence	2060	1598	1544	856	554	38	192	0	0	0	0	102	0	0
Brood stock removal	0	245	0	0	0	0	0	0	93	117	25	0	0	0
Farmed salmon removed	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Hook and release mortalities												8		
2 - Total	2087	1864	1551	860	556	43	200	2	98	124	34	118	5	8
Spawning escapement														
(1) - (2)	5428	7823	5567	3609	3765	2062	1783	2353	1435	3376	4402	2558	2926	2349
Egg deposition														
in millions of eggs	9.90	15.03	10.61	6.92	7.48	3.72	3.23	4.43	2.78	6.00	8.25	4.81	5.51	4.42
% of Management Target met	127	193	136	89	96	48	41	57	36	77	106	62	71	57
% of Conservation egg requirement met	228	346	245	160	172	86	75	102	64	138	190	111	127	102

* Food fishery includes fish caught in the estuary during tagging studies in 1986 and 1987. Proportions of Conne River origin salmon in 1986 and 1987 were 0.792 (N = 967) and 0.914 (N = 493), respectively. For remaining years, the weighted mean (0.833) was used.

Note: Results for 1994 are for wild fish only, and do NOT include any impact of the egg deposition 'equivalency' from fry reared in 1994-95. Count of small salmon in 1996 includes 286 fish that were derived from the release of the wild smolt aquaculture experiment.

Table 9. Total estimated returns of large salmon to Conne River, Newfoundland, with a summary of mortalities and removals and estimated spawning escapement, 1986-1999. Total estimated egg deposition from small and large salmon are also indicated along with the combined estimate of the percentage of the Management Target or Conservation egg requirement met.

	Year													
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Returns														
* Food Fishery (estuary)	14	18	2	1	11	2	4	2	0	0	0	1	0	0
Angling below fence	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mortalities below fence	1	0	0	0	0	0	1	0	0	0	0	0	1	0
Count at fence	397	498	418	319	361	67	154	98	100	110	179	184	294	241
Estimated count														
Total Returns	412	516	420	320	372	69	159	100	100	110	179	185	295	241
1 - Released at fence	397	498	418	319	361	67	154	96	100	110	179	184	294	241
Removals and mortalities														
Mortalities above fence/or in trap	1	0	0	0	0	0	1	1	0	2	0	0	0	1
Angling above fence	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brood stock removal		10							1	0	0	0	0	0
Farmed salmon removed												2		
Hook and release mortalities														
2 - Total	1	10	0	0	0	0	1	1	1	2	0	2	0	1
Spawning escapement														
(1) - (2)	396	488	418	319	361	67	153	97	99	108	179	182	294	240
Egg deposition														
in millions of eggs	1.48	2.07	1.77	1.09	1.23	0.30	0.52	0.33	0.34	0.37	0.61	0.62	1.01	0.86
% of Management Target met	19	27	23	14	16	4	7	4	4	5	8	8	13	11
% of Conservation egg requirement met	34	48	41	25	28	7	12	8	8	9	14	14	23	20
Total egg deposition - small and large salmon	11.36	17.10	12.38	8.01	8.71	4.01	3.76	4.76	3.12	6.37	8.86	5.44	6.51	5.28
Egg deposition per unit fluvial habitat	864	1297	939	608	661	304	285	361	236	483	672	413	494	401
Total % Management Target met	146	219	159	103	112	51	48	61	40	82	114	70	84	68
Total % Conservation requirement met	262	394	285	185	201	93	87	110	72	147	204	125	150	122

* Food fishery includes fish caught in the estuary during tagging studies in 1986 and 1987. Proportions of Conne River origin salmon in 1986 and 1987 were 0.792 (N = 967) and 0.914 (N = 493), respectively. For remaining years, the weighted mean (0.833) was used.

One unit of fluvial habitat = 100 m^2.
Conne River has an estimated 13,180 units of accessible fluvial habitat.

Table 10. Estimates of Atlantic salmon smolts from Conne River, 1987 - 1999, along with subsequent survival to both small salmon in year i + 1, and to 1SW salmon (repeat spawning fish omitted).

	Number of smolts			Population estimate			Survival		
	Upper site	Lower site					% survival		% survival
Year (i)	Tagged & released	Total number Captured	Tag Recoveries	N	Confidence Interval	Coeffiicient of variation %	to small salmon year i + 1	range	to 1SW salmon year i + 1
1987	4975	14314	980	74585	67597 - 81573	5.1	10.2	9.3 - 11.3	10.04
1988	3235	19515	1054	65692	59862 - 71522	4.8	7.6	6.9 - 8.3	7.25
1989	2699	16928	604	73724	66598 - 80850	5.1	7.3	6.7 - 8.1	7.16
1990	3719	13881	945	56943	52315 - 61571	4.4	4.2	3.9 - 4.6	3.80
1991	3753	9581	398	74645	62033 - 87527	9.0	3.4	2.9 - 4.1	3.03
1992	3758	10229	529	68208	61334 - 75052	5.4	4.0	3.6 - 4.4	3.56
1993	2456	15992	735	55765	51666 - 59864	3.9	2.7	2.6 - 3.0	2.47
1994	2366	11875	479	60762	53759 - 67765	6.2	5.8	5.2 - 6.5	5.66
1995	2558	12260	545	62749*	55300 - 70197	6.3	7.2	6.4 - 8.3	5.76
1996	3373	14575	499	94088	79867 - 108309	8.0	3.4	3.0 - 4.0	2.64
1997	3715	18290	662	100983	92812 - 109154	8.4	2.9	2.7 - 3.2	2.46
1998	2952	8636	367	69841	60617 - 79064	13.8	3.4	3.0 - 3.9	2.80
1999	2179	7545	258	63658	53305 - 74011	16.8	-	-	-

* Of these fish, 5016 smolt were transferred to sea cage holding facilities at Roti Bay.

Table 11. Estimated total number of migrating smolts in each age group by year, Conne River, Newfoundland, 1987-99, along with the corresponding number of smolts produced by year-class relative to the year eggs were spawned. Lower chart indicates the percentage of smolts at each river age.

Year	River age (y) 2	3	4	5	Total	Year Class (eggs)	Smolt Production
1987	1417	49002	22823	1343	74585	1984	59606
1988	0	39875	25029	788	65692	1985	69022
1989	2285	52197	17915	1327	73724	1986	57499
1990	399	39917	16228	399	56943	1987	76211
1991	896	59492	13660	597	74645	1988	65237
1992	409	50065	16097	1637	68208	1989	55006
1993	0	41266	14276	223	55765	1990	68021
1994	304	47880	12578	0	60762	1991	58776
1995	502	42858	18638	753	62749	1992	95707
1996	2729	75553	14301	1505	94088	1993	98561
1997	808	79978	18884	1313	100983	1994	65653 *
1998	978	52241	15854	768	69841		
1999	255	50799	12604	0	63658		

* 1994 year class complete to river age 4 smolts in 1999

Year	Percent in each age group 2	3	4	5	Number of samples
1987	1.9	65.7	30.6	1.8	271
1988	0.0	60.7	38.1	1.2	328
1989	3.1	70.8	24.3	1.8	288
1990	0.7	70.1	28.5	0.7	271
1991	1.2	79.7	18.3	0.8	246
1992	0.5	73.4	23.7	2.4	169
1993	0.0	74.0	25.6	0.4	246
1994	0.5	78.8	20.7	0.0	208
1995	0.8	68.3	29.7	1.2	249
1996	2.9	80.3	15.2	1.6	243
1997	0.8	79.2	18.7	1.3	380
1998	1.4	74.8	22.7	1.1	282
1999	0.4	79.8	19.8	0.0	257

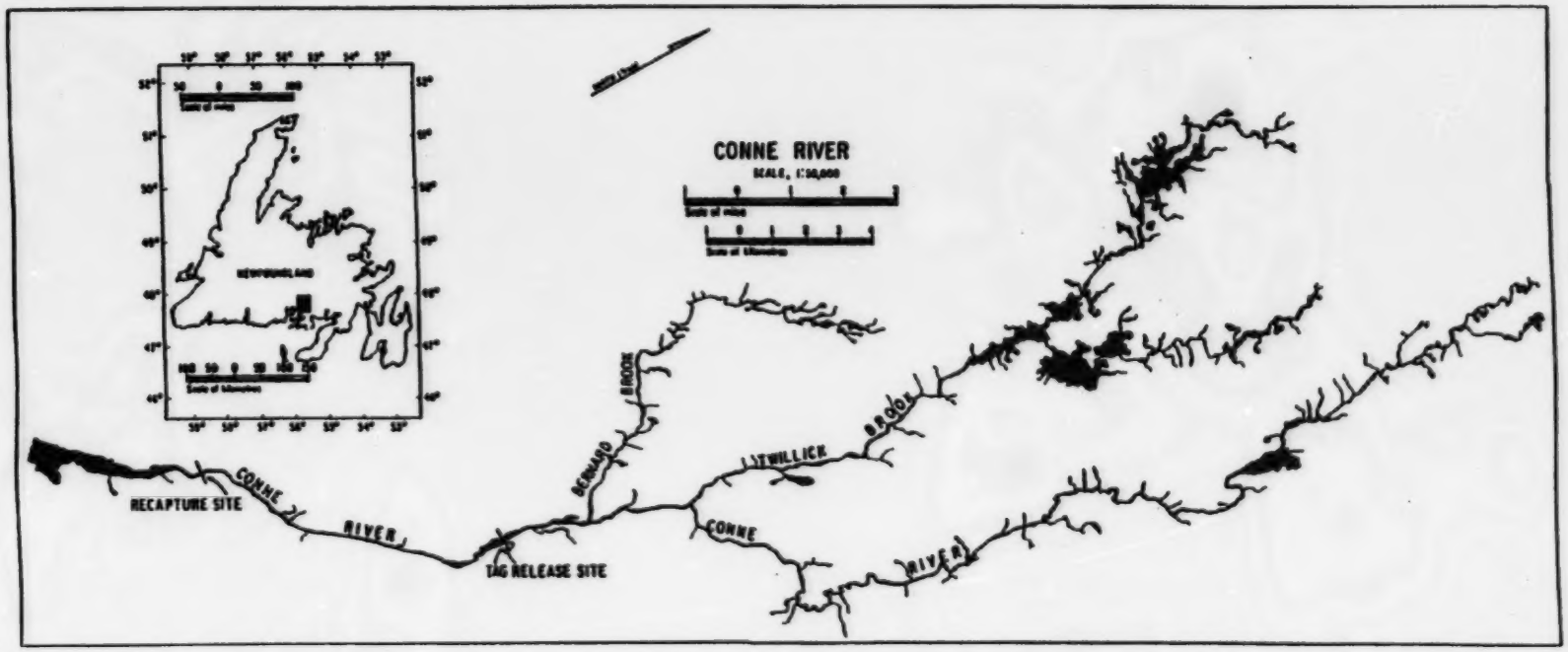

Fig. 1. Conne River, Newfoundland, SFA 11, illustrating the location of the fish counting fences used for the smolt mark-recapture survey. The recapture site is also the location of the upstream adult fish counting facility.

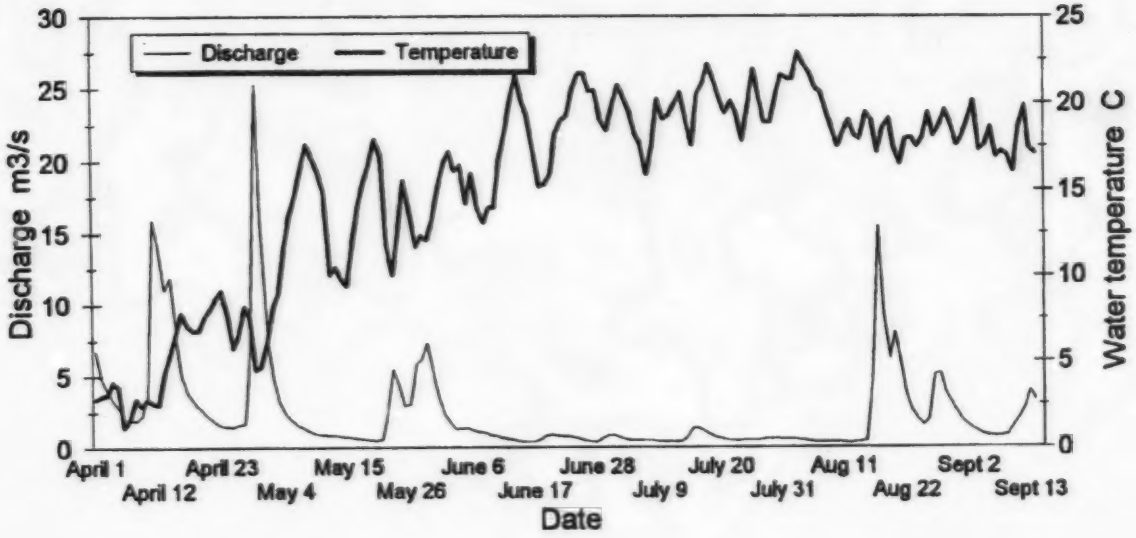

Figure 2. Discharge and temperature (April 1 - Sept. 14) profile at Conne River, Newfoundland, 1999. Discharge data from the Environment Canada monitoring station located below Conne Pond. Temperature data from a Hugrun thermograph located at the lower (adult) fish counting fence site.

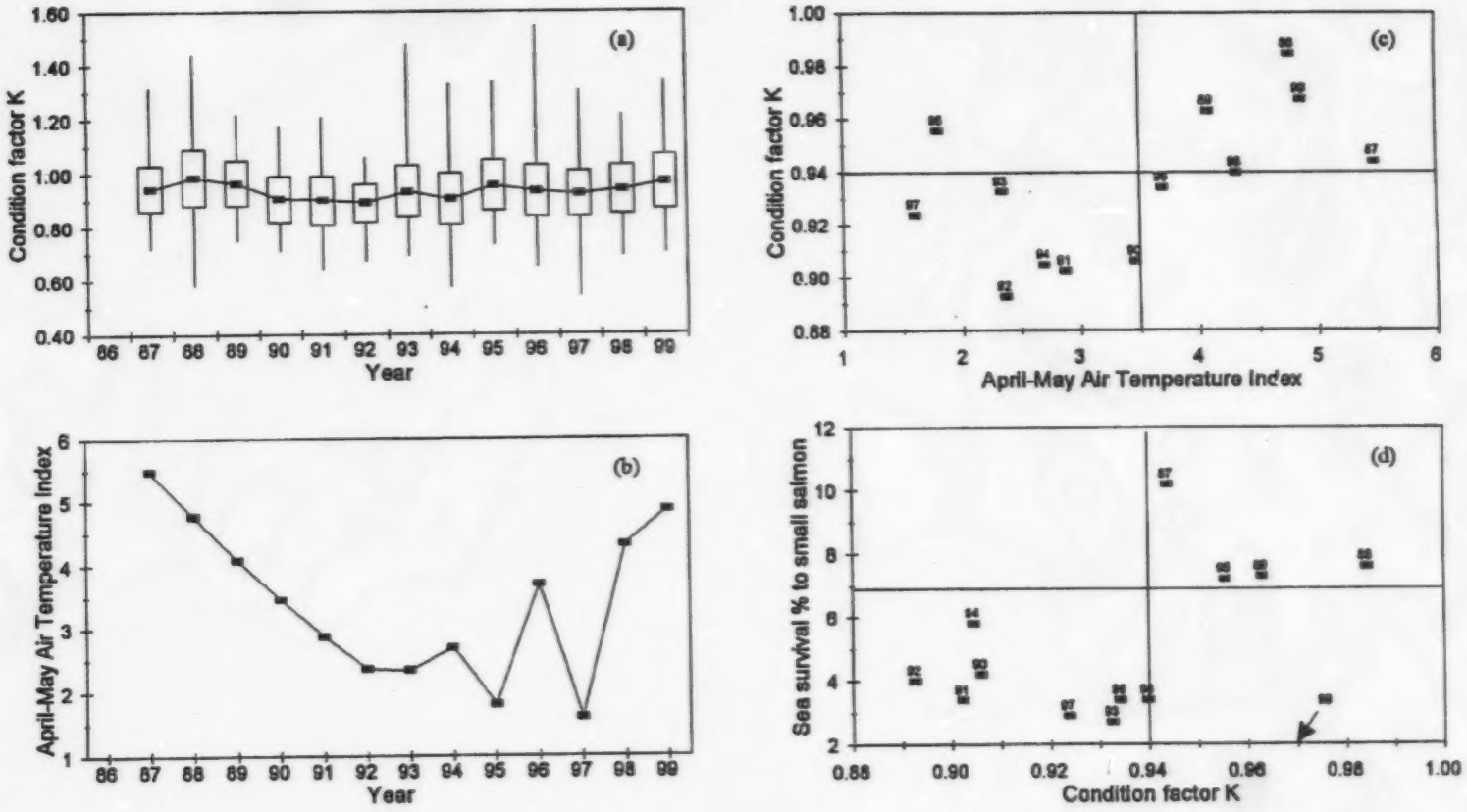

Figure 3. Trends in (a) Conne River smolt condition and (b) the April-May air temperature index over years; (c) smolt condition versus the air temperature index, and (d) sea survival (%) of small salmon versus smolt condition. Years shown refer to the year of smolt migration. In panel (d), the arrow indicates the 1999 smolt condition. In plot (a), vertical lines represent the minimum and maximum condition, the rectangle denotes one standard deviation about the mean which is the point within the rectangle.

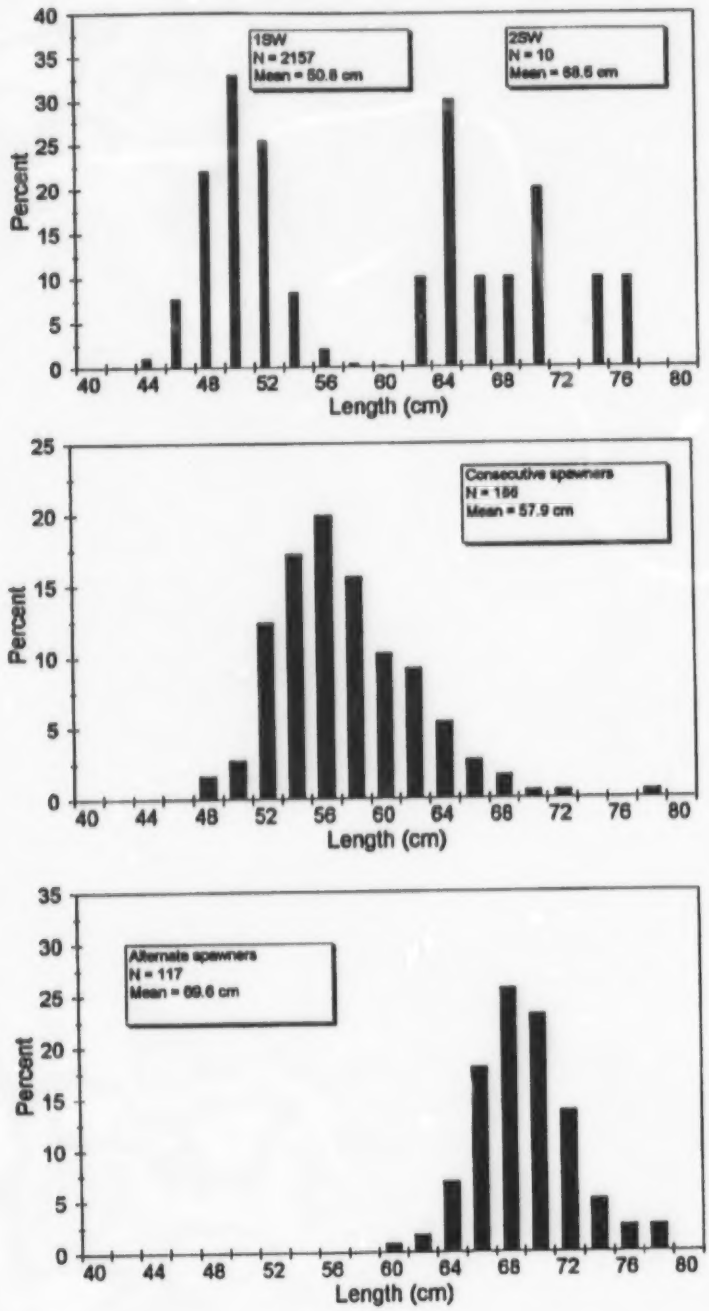

Figure 4. Length-frequency distribution of 1SW, 2SW, consecutive and alternate spawners, all years (1986-1999) combined, at Conne River, Newfoundland.

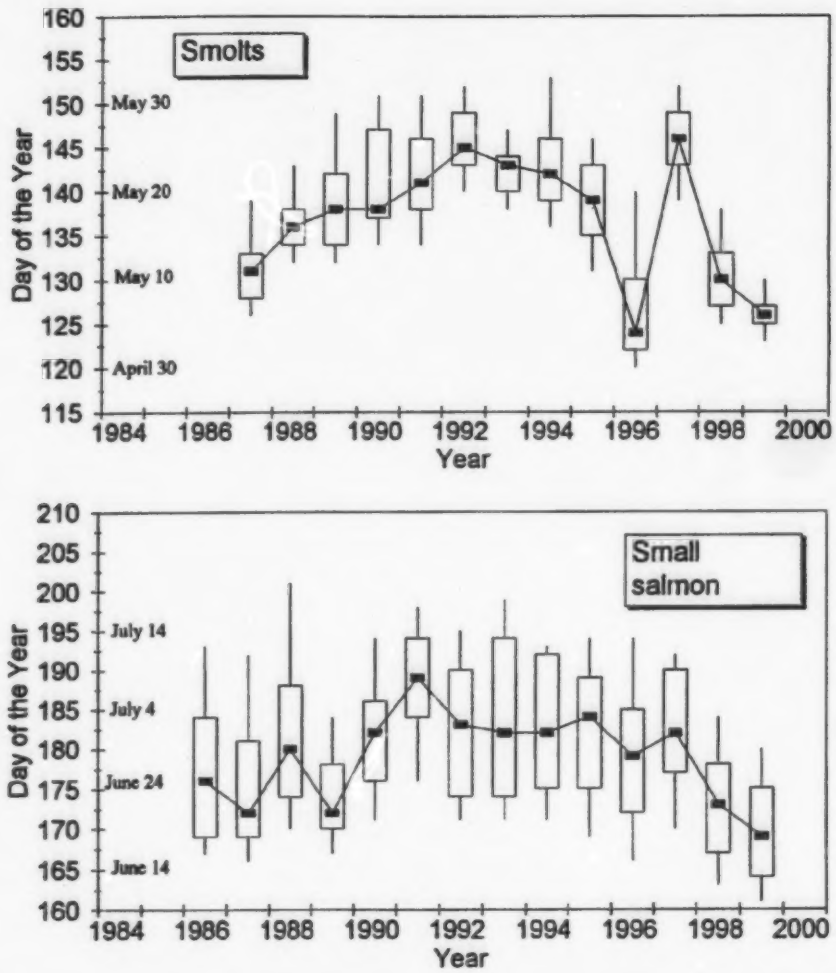

Figure 5. Annual variation in run timing at Conne River, Newfoundland, for Atlantic salmon smolts and returning small salmon. Vertical lines represent the 10th and 90th percentiles of the day of the year of migration, the rectangle is the 25th and 75th percentiles, and the marker within the rectangle is the median run timing value.

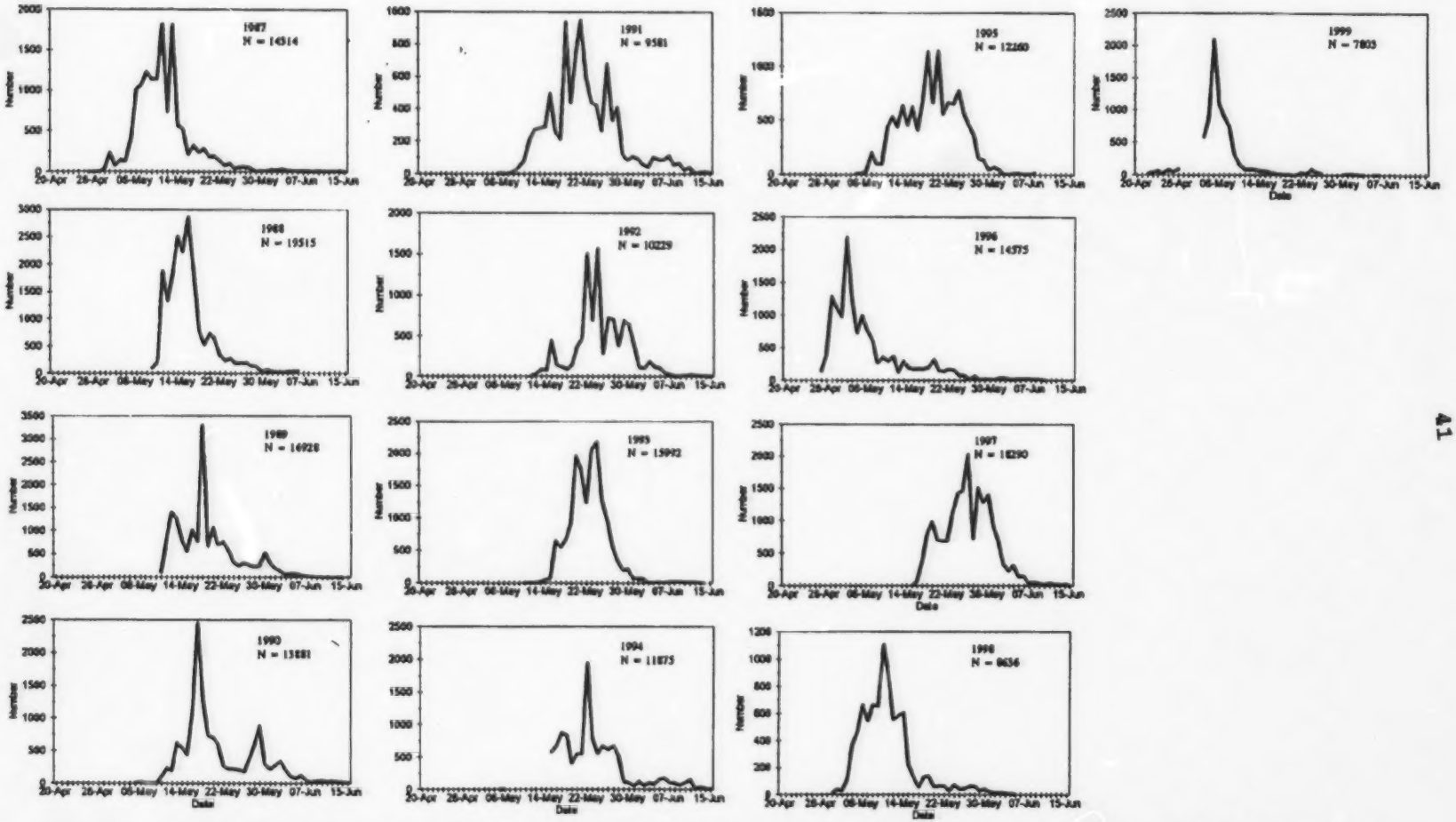

Figure 6. Numbers of Atlantic salmon smolts counted by day up to June 15 each year at the downstream fish counting fence trap at Conne River, Newfoundland, 1987 - 1999. N = total fence count of smolt for the season. Note that the total smolt population is estimated by mark-recapture.

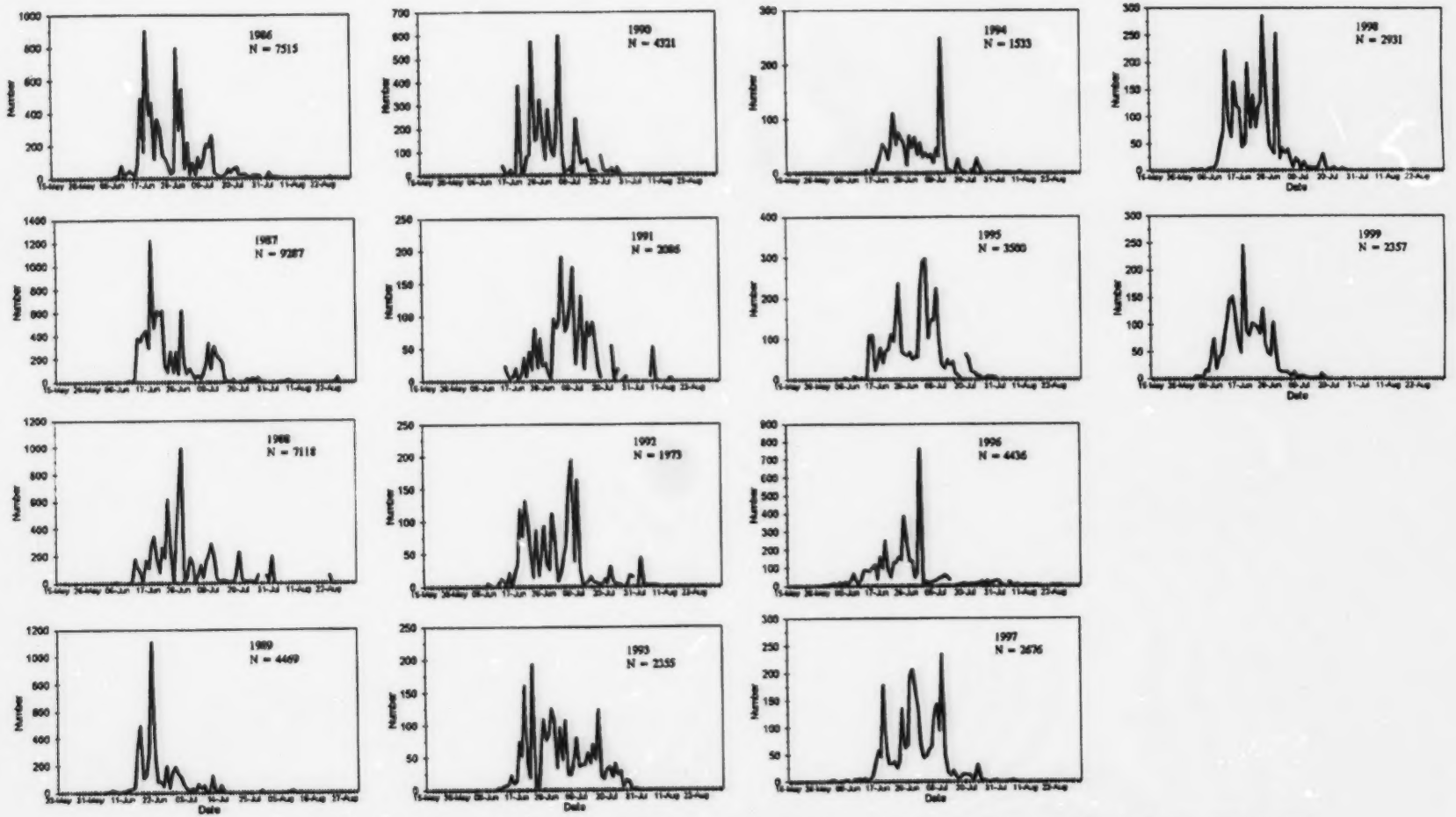

Figure 7. Numbers of small Atlantic salmon counted by day up to August 31 each year at the upstream fish counting fence at Conne River, Newfoundland, 1986 - 1999. N = total fence count of small salmon for the entire season.

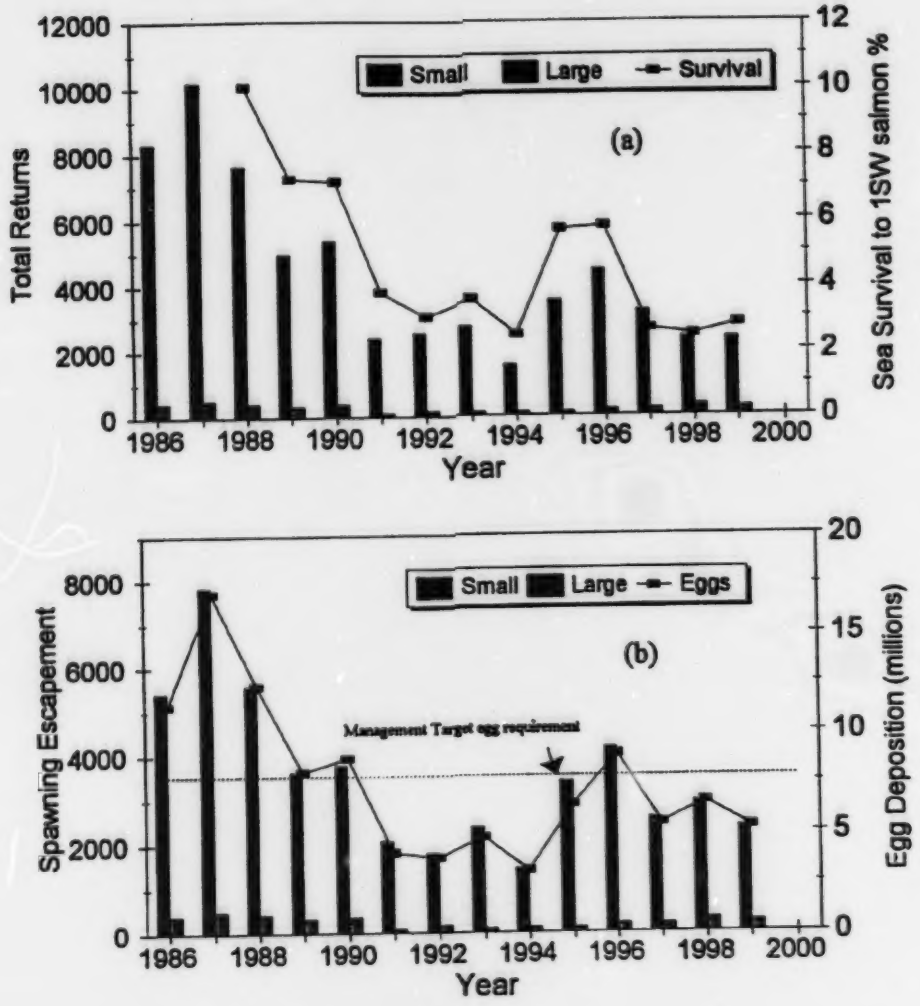

Figure 8. Total returns of small and large Atlantic salmon to Conne River, Newfoundland along with estimated sea survival from smolts to 1SW salmon (a). Survival estimates correspond to the year of adult return. Lower panel (b) illustrates the trend in spawning escapments and estimated egg deposition. The dashed horizontal line represents the current Management Target egg requirement.

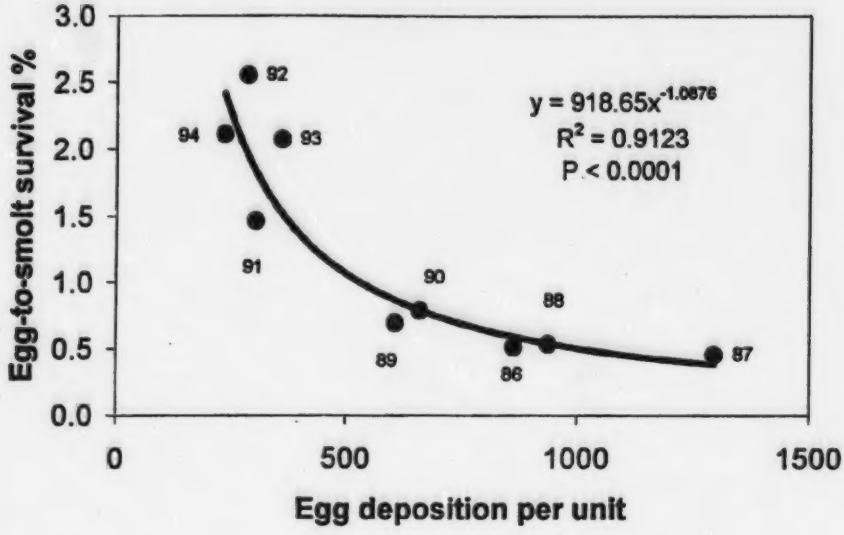

Fig. 9. Relationship between egg-to-smolt survival and the egg deposition rate per unit of fluvial habitat for Conne River, Newfoundland. Year shown refers to year of egg deposition

STOCK: Conne River (SFA 11) **Drainage area:** 602 km²

MANAGEMENT TARGET: 7.8 million eggs (~ 4,000 small salmon) calculated as fluvial area x 2.4 eggs/m² and lacustrine area x 368 eggs/ha

Year	1994	1995	1996	1997	1998	1999 [2]	MIN [1]	MAX [1]
Total returns to home waters								
Small	1533	3502	4440	3200	2931	2358	1533	10155
Large	100	110	179	185	295	241	89	516
First Peoples' harvest								
Small	0	0	0	514	0	0	0	948
Large	0	0	0	1	0	0	0	11
Recreational harvest (small salmon)								
Retained	-	-	-	197	-	-	108	3302
Released	-	-	-	80	-	-	0	80
Recreational harvest (large salmon)								
Retained	-	-	-	-	-	-	0	27
Released	-	-	-	0	-	-	0	0
Broodstock removal								
Small	93	117	25	0	0	0	25	245
Large	1	0	0	0	0	0	0	1
Spawners								
Small	1435	3376	4402	2558	2926	2349	1435	7823
Large	99	108	179	182	294	240	87	488
Management Target								
% met	40	82	114	70	84	68	40	214
Smolt estimate	60762	62749	94088	100983	69841	63658	55765	100983
% Sea survival (Adult return year)	2.7	5.8	7.2	3.4	2.9	3.4	2.7	10.2

[1] Min and max are for the period of record since 1974. First Peoples' harvest in salt water includes some salmon from other rivers. First Peoples' fishery quota of 1200 fish has been in effect since 1986, but was reduced to 500 fish for 1993. First Peoples' fishery and recreational fishery were closed again in 1998 and 1999.

[2] Preliminary

Data and methodology: Smolt estimates are derived from mark-recapture surveys. Returning adult salmon are enumerated at a fish counting fence. Angling harvets for Conne River are from DFO statistics. A video camera system was introduced in 1993.

State of the stock: The Management Target, which is higher than the conservation egg requirement, was met from 1986 to 1990 and again in 1996. Only 40-61% of the target was achieved from 1991-1994, rose to 81% in 1995 and was 68% in 1999. Sea survival to small salmon increased to 3.4% from 2.9% in the previous year. In contrast with the Mangement Target, the Conservation egg requirement was met or exceeded from 1986-1990, in 1993, and again from 1995 - 1999.

Forecast:

Based upon the point estimate of the number of smolts that migrated in 1999, a marine survival rate of 3.9% would be required in order for the conservation requirement to be attained in 2000, while a survial of 6.3% would be needed to meet the Management Target. Both values are higher than that observed during the past three years.